TECHNICAL MANUAL

CONTROL, DECONTAMINATION, AND DISPOSAL OF MERCURY

(ATOS)

F41608-78-D-A005

F41608-84-D-A384

Prepared By: TRI-COR Industries, Inc.

Published Under Authority of the Secretary of the Air Force

30 APRIL 2004 **CHANGE 1 - 1 AUGUST 2005**

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

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Original..... 0 ..... 30 April 2004 Change ..... 1 ..... 1 August 2005

TOTAL NUMBER OF PAGES IN THIS MANUAL IS 16, CONSISTING OF THE FOLLOWING:

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INTRODUCTION

1. PURPOSE.

The purpose of this manual is to provide guidance and instructions for the safe control, clean-up, decontamination, and disposal of mercury. It applies to all activities using, handling, and storing mercury. Common uses include precision measuring devices such as manometers, barometers, and thermometers. Mercury can also be found in some relays and types of lamps. Inquiries in regard to this manual should be directed to: DET 3, WR-ALC/AFTT, Wright-Patterson AFB, OH 45433-7632, DSN 785-8050, or e-mail: afpet.aftt@wpafb.af.mil.

2. SCOPE.

This manual covers the control, monitoring, cleanup and disposal of mercury. It gives directions on how to remove mercury from the precision measuring equipment at laboratories and lists the consumable materials that are required in the mercury removal.

SAFETY SUMMARY

1. THRESHOLD LIMIT VALUE (TLV).

WARNING

At ambient or room temperatures, mercury is a liquid metal having a vapor pressure sufficiently high to produce mercurial poisoning if a considerable area of the metal is exposed to ambient air. If mercury is heated, the results can be fatal. In the event of spillage, contact the Base Bio-Environmental Engineers for clean-up and monitoring recommendations. Wash hands thoroughly after contact since mercury can be absorbed through the skin. To avoid possible contamination, do not expose metallic objects such as rings and watches to mercury. For personal protective equipment requirements see the Safety Summary and Table 3-2.

At room temperature mercury readily vaporizes creating a hazardous environment in a small unventilated room. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a TLV, based on an 8-hour Time Weighted Average (TWA), of 0.025 mg/m^3. The Immediately Dangerous to Life or Health (IDLH) concentration is 10 mg/m^3.

Mercury can enter the body by ingestion, inhalation, or absorption through the skin. The Central Nervous System (CNS) and kidneys are the primary sites where mercury accumulates in the human body. With acute mercury exposure the CNS will be the first organ system affected whereas with chronic exposure both CNS and the kidneys may be affected.

2. SYMPTOMS OF MERCURY POISONING.

The following symptoms and signs may occur in less severe mercury poisoning and their occurrence should prompt further study. The symptoms are weakness, fatigue, loss of appetite and weight, indigestion, diarrhea, metallic taste in mouth, increased flow of saliva, soreness of the mouth or throat, inflammation of the gums, black line on the gums, loosening of the teeth, irritability, loss of memory, and tremor of the fingers, eyelids, lips, or tongue. Exposure to high concentration (1.2 mg/m^3) of vapors for brief periods can cause pneumonitis, chest pains, dyspnea, coughing; later stomatitis, gingivitis, and salivation occurs. Chronic symptoms involve the CNS with tremors and various neuropsychiatric disturbances.

3. SAFETY MEASURES.

a. First Aid Treatments.

(1) Eye Contact – flush with running water for 15 minutes including under the eyelids.

(2) Skin Contact – remove contaminated clothing, wash areas with soap and water.

(3) Inhalation – remove to fresh air. Restore and/or support breathing as needed. Administer oxygen for chemically induced pneumonitis.

(4) Ingestion – Seek medical assistance for treatment, observation, and support.

b. Respiratory Protection.

(1) Concentrations Below 0.5 mg/m^3:

(a) Supplied Air – may be used for all exposures, but must be used whenever the exposure level exceeds 0.5 mg/m^3.

(b) MSA Comfo Classic Half-Mask Respirators (P/N 30455) with Mersorb Cartridge (P/N 18813) may be used for all exposures below 0.5 mg/m^3.

(c) Other Comfo Classic Respirators (half-face or full-face) with the Mersorb Cartridges (P/N 18813) may be used for exposures below 0.5 mg/m^3 upon the approval of the Base Bio-Environmental Engineer, provided they are established and documented to ensure the end-of-service life indicators are checked every half hour.

(d) Deleted

(2) Concentrations Above 0.5 mg/m^3 – requires either a continuous flow, positive pressure, air line respirator with full-face mask or a full-faced, self-contained, positive pressure-demand breathing apparatus.

c. Protective Clothing.

1. Safety Glasses

2. Rubber Gloves

3. Coveralls of a Nonwoven or Tightly Woven Fabric Which Exhibit a Minimum Tendency to Absorb Mercury

NOTE

Personal protective equipment is not acceptable as a substitute for adequate engineering controls, but is appropriate for unavoidable exposures where excessive atmospheric concentrations result from emergencies or for short term maintenance or repair operations.

d. Additional Protective Measures.

(1) Clothing should be checked for mercury following a spill or manometer blowout since droplets can be deposited in trouser cuffs, pockets, and shoes.

(2) No smoking, drinking, or eating is permitted in areas containing mercury. Area cleanliness and personal hygiene must be stressed.

(3) Adequate exhaust ventilation must be provided to meet TLV requirements in the workplace.

(4) Manometers shall be provided with mercury traps and check valves to prevent blowouts.

4. FIRE AND EXPLOSION DATA.

a. Nonflammable and nonexplosive in air.

b. Use extinguishing media suitable for surrounding fire.

c. When exposed to high temperatures, mercury vaporizes to form extremely toxic fumes. Firefighters need to use a self-contained breathing apparatus.

5. REACTIVITY.

a. Oxidizes slowly. Reacts with halogens. For example, at 200° – 300°C (392° – 572°F) a flame forms when a jet of chlorine gas is directed over mercury.

b. Reacts with oxidizing acids such as nitric but not with hydrochloric. Boron phosphodiiodide will ignite in mercury vapor.

c. Will react with the following forming explosive mixtures: acetylene, ammonia, chlorine dioxide, nitric acid plus ethanol, and methyl azide.

d. Will form amalgamates with many metals. Mercury in sewer drains will amalgamate with lead and may cause leaded joints to leak. Contact with mercury may damage metal parts, airframe components, and jewelry.

CHAPTER 1
CONTROL, MONITORING, CLEAN-UP/DISPOSAL, AND DECONTAMINATION OF MERCURY

1.1 GENERAL INFORMATION.

1.2 BACKGROUND.

Mercury spills are difficult to clean up and decontaminate because of certain properties. Mercury is a highly insoluble, dense metal which is liquid at room temperature. Silver-white in appearance, its high surface tension makes it very difficult to pick up without special apparatus. Pouring without splashing and spilling is almost impossible. Mercury does not wet most surfaces but forms droplets that when disturbed break into finer drops. Drops tend to roll away entering small cracks, holes, and porous materials where its high vapor pressure creates an insidious health hazard. See Table 1-1 for more detailed chemical description.

1.3 GENERAL GUIDELINES FOR MERCURY CONTROL.

WARNING

At ambient or room temperatures, mercury is a liquid metal having a vapor pressure sufficiently high to produce mercurial poisoning if a considerable area of the metal is exposed to ambient air. If mercury is heated, the results can be fatal. In the event of spillage, contact the Base Bio-Environmental Engineers for clean-up and monitoring recommendations. Wash hands thoroughly after contact since mercury can be absorbed through the skin. To avoid possible contamination, do not expose metallic objects, such as rings and watches to mercury. For personal protective equipment requirements see the Safety Summary and Table 3-2.

a. The control of mercury exposures is facilitated if flooring materials are made of nonporous, seamless, and impervious materials. Carpeting or asphalt tile with its numerous joints is not recommended. Seamless (or with the minimum number of sealed joints) sheet vinyl flooring which turns up at the walls is recommended. A nonskid floor wax should be applied to the surface to seal pores. Work benches or table tops where mercury is used should be fitted with trays or retaining walls to contain spills.

b. Sufficient general ventilation should be provided to prevent an increase of mercury vapor in the air in the event of a spill. The atmosphere should be monitored annually for contamination by Bio-Environmental Engineering. Dosimeters can also be worn to determine long term exposure levels. In areas where air samples indicate higher than normal levels of mercury, local exhaust ventilation may be effective in controlling the vapor emissions. Spilled mercury should be promptly cleaned up and the area decontaminated as detailed in this T.O.

c. In laboratories or areas where mercury is handled regularly, clothes and shoes used in the work area should be removed before leaving the area. Coveralls of a nonwoven or tightly woven fabric which exhibit a minimum tendency to absorb mercury should be worn. Clothing should be checked for mercury following a spill or manometer blowout since droplets can be deposited in trouser cuffs, pockets, and shoes.

d. No smoking, drinking, or eating should be permitted where mercury is used. Area cleanliness and personnel hygiene must be stressed.

e. Manometers shall be provided with mercury traps and check valves to prevent blowouts.

f. Mercury must be stored in closed, polyethylene-coated or plastic-coated glass containers to minimize problems with breakage. Shipping cartons containing mercury should have a label warning against using a knife with a downward motion to open the carton to prevent cutting the bottles. Where possible, mercury containers and processes should be enclosed or separated from other operations.

1.4 CLEAN-UP OF MERCURY SPILLS.

WARNING

At ambient or room temperatures, mercury is a liquid metal having a vapor pressure sufficiently high to produce mercurial poisoning if a considerable area of the metal is exposed to ambient air. If mercury is heated, the results can be fatal. In the event of spillage, contact the Base Bio-Environmental Engineers for clean-up and monitoring recommendations. Wash hands thoroughly after contact since mercury can be absorbed through the skin. To avoid possible contamination, do not expose metallic objects, such as rings and watches to mercury. For personal protective equipment requirements see the Safety Summary and Table 3-2.

a. Accidental spills of mercury must be cleaned up immediately to prevent vapors from entering the air. In the event of a major spill (20 ml or greater) the using agency should contact the Bio-Environmental Engineering service for assistance to ensure complete clean-up.

WARNING

Industrial and household vacuum cleaners are not designed to resist the corrosion of mercury. They also have been shown to increase airborne mercury levels and to spread contamination throughout facilities. Use only vacuum cleaners approved for mercury service and according to manufacturers' operating instructions.

b. Spilled mercury shall be cleaned up using either a mercury control kit following the instructions provided in the kit, vacuum cleaner designed for cleaning up mercury spills, or for small spills a suction bottle with a capillary tube can be used. See Chapter 3, Equipment and Consumables.

c. Large spills should be monitored with the Jerome Mercury Vapor Analyzer during any clean-up and decontaminating procedures. Contact the Local Base Bio-Environmental Engineers for assistance. If a Jerome Mercury Vapor Analyzer is not available, the Local Base Bio-Environmental Engineers may obtain a loaner from the USAF Occupational and Environmental Health Laboratory (USAFOEHL) at Brooks AFB, TX 78235-5501, 888-232-3764 or DSN: 240-5454. If time does not permit this action, good ventilation must be provided and the use of respirators is required during clean-up and decontamination. Bases with major Precision Measuring Equipment Laboratories (PMEL) facilities, extensive engine test stand facilities, or major USAF medical facilities with associated dental facilities should have a mercury vapor analyzer on hand.

1.5 DECONTAMINATING MERCURY SPILLS.

WARNING

At ambient or room temperatures, mercury is a liquid metal having a vapor pressure sufficiently high to produce mercurial poisoning if a considerable area of the metal is exposed to ambient air. If mercury is heated, the results can be fatal. In the event of spillage, contact the Base Bio-Environmental Engineers for clean-up and monitoring recommendations. Wash hands thoroughly after contact since mercury can be absorbed through the skin. To avoid possible contamination, do not expose metallic objects, such as rings and watches to mercury. For personal protective equipment requirements see the Safety Summary and Table 3-2.

a. After removing the visible mercury, the contaminated surface should be cleaned following instructions in mercury spill control kit or by liberally cleaning with HgX (calcium polysulfide) solution.

b. If available, a screening test should be performed with the Jerome Mercury Vapor Analyzer (Model 411 or 431-X) to find local pockets of mercury.

c. If results are greater than the current American Conference of Government Industrial Hygienists (ACGIH) Threshold Limit Value-Time Weighted Average (TLV-TWA) measured at the breathing zones, continue cleaning surface with HgX solution and/or Hg absorb powder which will further suppress vaporization.

d. Carpeting should not be used in area where there is a high potential for mercury contamination. Existing carpeting, once its useful life has expired, should be replaced with seamless sheet vinyl flooring which turns up at the walls. Once carpeting has been contaminated, it is practically impossible to decontaminate to an acceptable level. Disposal of contaminated carpeting and mats which cannot be cleaned/decontaminated adequately is a difficult task and will vary according to local environmental protection standards. Contact the Local Civil Engineering Environmental Coordinator or the Local Bio-Environmental Engineer for disposal instructions.

1.6 DISPOSAL OF MERCURY, AMALGAMS, AND CONTAMINATED MATERIALS.

WARNING

At ambient or room temperatures, mercury is a liquid metal having a vapor pressure sufficiently high to produce mercurial poisoning if a considerable area of the metal is exposed to ambient air. If mercury is heated, the results can be fatal. In the event of spillage, contact the Base Bio-Environmental Engineers for clean-up and monitoring recommendations. Wash hands thoroughly after contact since mercury can be absorbed through the skin. To avoid possible contamination, do not expose metallic objects, such as rings and watches to mercury. For personal protective equipment requirements see the Safety Summary and Table 3-2.

a. Spilled mercury and scrap amalgams must be kept in tightly closed plastic or plastic coated glass containers, containing HgX solution in a sufficient quantity to completely cover the waste. Scrap amalgams must not be discarded as normal waste. This material should be disposed of through the Defense Reutilization and Marketing Office (DRMO). Information regarding hazardous waste disposal can be found in DoD 4160.21-M, Defense Materiel Disposition Manual, Chapter 4, Property Requiring Special Processing. For large quantities of mercury, a commercial mercury processor might be utilized for disposal and/or reprocessing.

b. Articles contaminated with mercury (paper tissue, chamois leather, etc.) should be kept in sealed containers until disposal can be arranged. Use the sealed container by: (1) placing contaminated articles in polyethylene bags to contain any loose mercury; (2) placing the bag inside a metal drum; and (3) securing the seal on the container. The container should contain a label stating, CONTAINS MERCURY CONTAMINATED ARTICLES. CONTACT THE BASE BIO-ENVIRONMENTAL ENGINEERING SECTION FOR ADVICE ON HANDLING, STORAGE, AND DISPOSAL PROCEDURES. Recommend high temperature incineration of these items or burial at a chemical waste landfill at U.S. Environmental Protection Agency licensed facilities.

Table 1-1. Chemical Description of Mercury

SECTION I. MATERIAL IDENTIFICATION	
DESCRIPTION:	A liquid, metallic element.
OTHER DESIGNATIONS:	Quick Silver, CAS # 7439-97-6, Hg
MANUFACTURER:	Available from many sources.
SECTION II. HAZARDS	
8-hr TWA:	0.05 mg/m^3 (refer to Note (1))
Toxic Effects (TFX):	Gastro-Intestinal (GI), Central Nervous System (CNS)
Human, Oral, Lowest Published Lethal Dose (LDLo):	LDLo 1429 mg/kg
Women, Inhalation, Lowest Published Toxic Dose (TDLo):	TDLo 150 µg/m^3/46D
SECTION III. PHYSICAL DATA	
Boiling Point: 356.5°C (673.7°F)	Specific Gravity: 13.5
Vapor Pressure at 20°C (68°F): 0.0012 mm Hg at 126°C (258.8°F): 1 mm Hg	Melting Point: –38.9°C (–38°F)
	Atomic Weight: 200.61
Water Solubility: Insoluble	Atomic Number: 80
Appearance: A silvery, dense mobile liquid	Odor: Odorless (vapor has no warning properties)
Note (1): ACGIH (1981) TLV. Current OSHA Standard is 0.1 mg/m^3 ceiling level.	

CHAPTER 2
REMOVAL OF MERCURY FROM PRECISION MEASURING EQUIPMENT AT BASE OR ALC PRECISION MEASUREMENT EQUIPMENT LABORATORIES

2.1 GENERAL.

Remove mercury from Precision Measurement Equipment (PME) as follows:

Place a glass, stainless steel, or acid resistant plastic tray under precision measuring equipment and containers when transferring mercury to catch spillage and facilitate clean-up.

WARNING

Inlets of vacuum pumps shall be equipped with a mercury absorption filter to prevent emission of mercury vapors to atmosphere from vacuum pump.

a. Mercury can be removed from precision measurement equipment using the method in Figure 2-1 or as required in appropriate operation maintenance manuals.

b. Mercury that has been utilized for calibrating clean precision measurement equipment will not be considered as contaminated unless it has come in contact with impurities as can be noted by its lack of mirror-like luster.

2.2 CONTAMINATED MERCURY.

a. Mercury that has been stored for a period of time must be checked for surface scums prior to use. Should any doubt exist concerning its purity, it will be considered contaminated.

b. Contaminated mercury can be detected by noting its surface, i.e. scum floating on its surface will obscure its mirror-like luster. It will also tend to adhere to a clean surface, leaving scum or small droplets of mercury behind, instead of moving freely and remaining intact.

c. Contaminated mercury should be removed from precision measurement equipment.

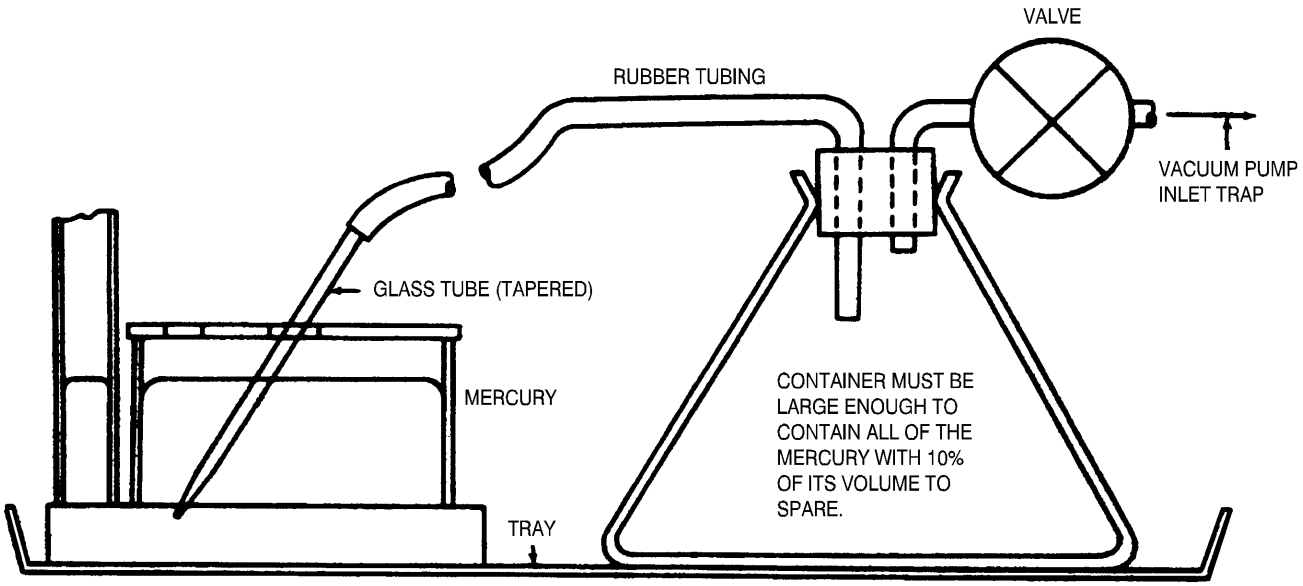

Figure 2-1. Removal of Mercury from PME

CHAPTER 3
EQUIPMENT AND CONSUMABLES MATERIALS

3.1 INTRODUCTION.

Special clean-up/control equipment, personal protective equipment, and consumable materials required are provided in this chapter. Equivalent items are not to be used without the authorization of the Local Base Bio-Environmental Engineer or USAFOEHL.

3.2 CLEAN-UP/CONTROL EQUIPMENT.

Special equipment for the control and clean-up of mercury is listed in Table 3-1.

3.3 PERSONAL PROTECTIVE EQUIPMENT.

Personal protective equipment required during clean-up of mercury spills are listed in Table 3-2.

3.4 CONSUMABLES MATERIALS.

Consumable materials required are listed in Table 3-3.

Table 3-1. Clean-Up/Control Equipment

Nomenclature	NSN or P/N (MFG Code)
Mercury Analyzers and Dosimeters:	
Jerome Model 411 Gold Film Mercury Analyzer	NSN 6605-01-230-7323 Arizona Instrument LLC (59830)
Jerome Model 431-X, Mercury Analyzer	NSN 6630-01-510-9260 Arizona Instrument LLC (1DS44)
Personal Monitoring Systems – Mercury Vapor Badge	P/N 47275 Lab Safety Supply (6M644) Phone Number: (800)356-0783 URL: http://www.labsafety.com/
Mercury Vacuum Cleaners:	
Lab Safety Mercury Vacuum Cleaner Nilfisk Mini-Merc Mercury Vacuum Cleaner	P/N 9981 Lab Safety Supply (6M644)
Mercury Spill Control Kits:	
Mercury Spill Control Station	P/N 20754 Lab Safety Supply (6M644)

Table 3-2. Personal Protective Equipment

Nomenclature	P/N (MFG Code)
Respirators:	
MSA Comfo Classic Half-Mask Respirators	P/N 30455 Lab Safety Supply (6M644)

Table 3-3. Consumable Materials

Nomenclature	NSN or P/N (MFG Code)
Disposable Nitrile Gloves:	
Small Size	NSN 8415-01-492-0176
Medium Size	NSN 8415-01-492-0179
Large Size	NSN 8415-01-492-0178
X-Large Size	NSN 8415-01-492-0180
Respirator Cartridges:	
Mercury Vapor Chlorine Cartridge	P/N 18813 Lab Safety Supply (6M644)
Replacement Chemicals:	
Refill Pack for Mercury Spill Control Station	P/N 16613 Lab Safety Supply (6M644)
Decontaminating Agent, Mercury (HgX) 1.5 lb	NSN 6850-01-230-8556